Method for Estimating Emissions Reductions for Composting

April 21, 2016

Life-cycle Analysis

- ARB in collaboration with CalRecycle have updated the compost emission reduction factor (CERF)

- The purpose of this report is to explain a life-cycle method to quantify the California-specific GHG emission reductions from using compost and the GHG emissions associated with compost management

GHG Emissions and Benefits

- This method evaluates the GHG emissions of composting and GHG emissions reduction benefits associated with the agricultural use of composting end-products, as compared to a baseline scenario of waste landfilling with gas collection

Baseline Scenario
Waste Landfilling and Gas Collection

Alternative Scenario
Composting and Agricultural Use

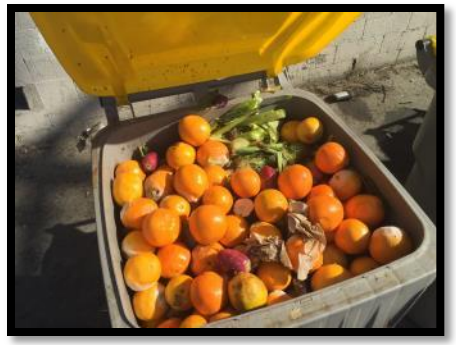
GHG Emissions and Benefits

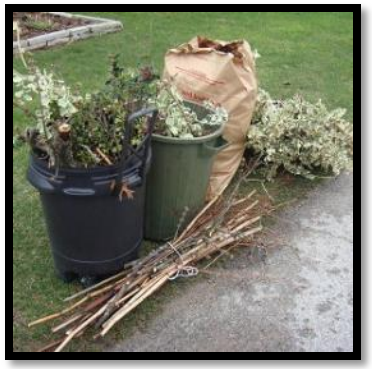
- The **GHG emissions** considered are:
  - transportation
  - process emissions
  - fugitive CH_4 and N_2O emissions

- The **GHG emissions reduction benefits** considered are:
  - avoided methane emissions from landfilling
  - reduced soil erosion
  - decrease in fertilizer and herbicide use

Compost Emission Reduction Factor (CERF)

- CERF was determined for food waste, yard trimmings, and mixed organics
- CERF = $B_{total} - E_{total}$
- B_{total} = total emission reduction **benefit** due to application of compost
- E_{total} = total **emissions** due to composting





Composting Emissions (E_{total})

- $E_{total} = T_e + P_e + F_e$
- E_{total} = total emission from composting
- T_e = net additional transportation emissions from composting as compared to landfilling
- P_e = Net additional process emissions from composting as compared to landfilling
- F_e = fugitive emissions from composting

Composting Emissions (E_{total})

Emission Type	Emission ($MTCO_2E$/ton of feedstock)
Transportation emissions (T_e)	0
Process emissions (P_e)	0
Fugitive CH_4 emissions (F_e)	0.049
Fugitive N_2O emissions (F_e)	0.021
Total	**0.070**

$$E_{total} = T_e + P_e + F_e$$

Compost Emission Reductions (B_{total})

- $B_{total} = ALF_b + ((E_b + F_b + H_b) * C_{use})$
- B_{total} = total emission reduction benefit due to compost use
- ALF_b = emission reductions associated with the avoidance of methane emissions at landfills
- E_b = emission reduction associated with decreased soil erosion
- F_b = factor to account for reduced fertilizer use
- H_b = factor to account for reduced herbicide use
- C_{use} = conversion factor to convert from tons to compost to tons of feedstock

Compost Emission Reductions (B_{total})

Emission reduction type	Emission reduction ($MTCO_2E$/ton of feedstock)	Conversion factor (C_{use})	Final emission reduction by waste type ($MTCO_2E$/ton of feedstock)		
			Food waste	Yard trimmings	Mixed Organics
Avoided landfill emissions (ALF_b)	N/A	N/A	0.39	0.21	0.33
Decreased soil erosion (E_b)	0.25	0.58	0.15	0.15	0.15
Decreased fertilizer use (F_b)	0.26	0.58	0.15	0.15	0.15
Decreased herbicide use (H_b)	0.0	0.58	0.0	0.0	0.0
Total	**N/A**	**N/A**	**0.69**	**0.51**	**0.63**

$$B_{total} = ALF_b + ((E_b + F_b + H_b) * C_{use})$$

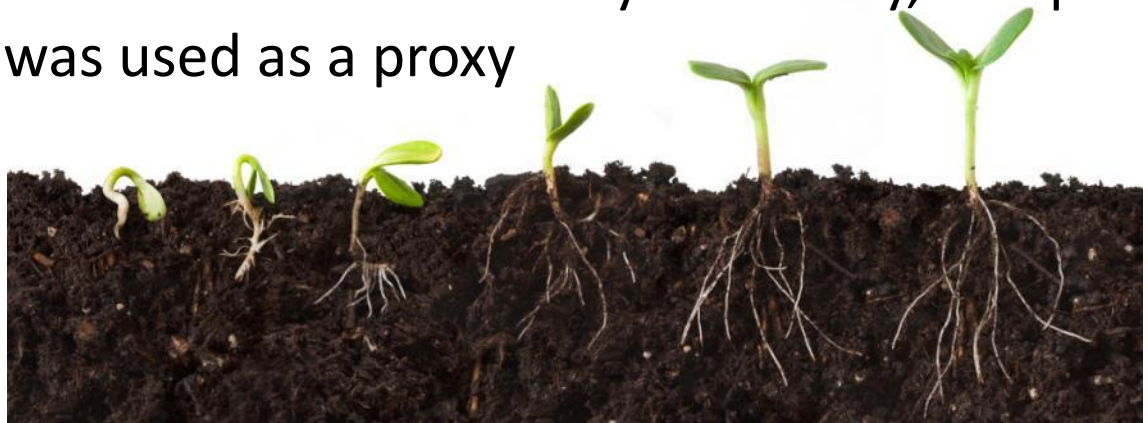
Final Compost Emission Reduction Factor

Waste Type	Composting Benefits (B_{total})	Composting Emissions (E_{total})	Final CERF ($MTCO_2E$/ton waste input)
Food waste	0.69	0.07	0.62
Yard trimmings	0.51	0.07	0.44
Mixed Organics	0.63	0.07	0.56

$$CERF = B_{total} - E_{total}$$

Variability Analysis

- Uncertainty due to:
  - Variability in the compost processing and physical soil properties
  - Lack of scientific understanding of emissions pathways for landfills and compost piles
  - Absence of literature articles
  - Reliance on non-California specific study locations and default assumptions
- Erosion and water use results were extrapolated from lab-scale experiments instead of macro scale field methods
- Herbicide results were based on only one study, and pesticide life-cycle information was used as a proxy



Public Comments

- The draft document is available for public comment through May 6, 2016

- Comments can be sent:
  - via email to Ms. Mei Fong at mei.fong@arb.ca.gov
  - mailed to Mr. Robert Krieger, Emissions Assessment Branch, P.O. Box 2815, Sacramento, CA 95812

- Visit the Waste Management Sector website at http://www.arb.ca.gov/cc/waste/waste.htm for more information

Staff Recommendation

- Staff recommends that Task Force send a comment letter to ARB regarding:

- Process emissions from composting
- Transportation emissions from composting and landfilling
- Total composting emissions calculated
- Reduced fertilizer use emissions reduction benefit from compost application
- Laboratory scale experiment versus macro scale field studies
- Large uncertainty in factors
- Emissions reduction benefits from water use